THE RESPONSE OF WEANER RABBITS FED UREA-TREATED AND FERMENTED BREWER'S DRIED GRAINS IN PLACE OF GROUNDNUT CAKE

JONATHAN O. ISIKWENU

Department of Animal Science,
Delta State University, Asaba Campus, Nigeria.

jisikwenu@yahoo.com

Date submitted: 20 June, 2014; Date accepted: 30 August, 2014

Abstract

The effects of replacing groundnut cake (GNC) with urea-treated and fermented brewer's dried grains in weaner-rabbits diets were investigated. Urea-treated and fermented brewer's dried grains were used to replace GNC at 0, 25, 50, 75 and 100% levels in weaner rabbit diets. Diets were formulated to be isonitrogenous and isocaloric to provide 18% crude protein and 2600 kcal/kg metabolizable energy. Thirty eight-weeks old weaner rabbits of mixed breeds and sexes were randomly allocated to five treatment groups on equal weight and sex basis made up of two rabbits per replicate and six rabbits per treatment and fed *ad libitum* in hutches for ten weeks. Significant ($P<0.05$) differences were observed in final body weight, daily body weight gain, feed intake, feed conversion ratio, carcass and organ weights for all treatment groups. Cost reduction and savings were better with 50% urea-treated and fermented BDG diet. Mortality level (3-7%) was normal and evenly spread across treatment groups.

Keywords: Urea-treated, fermentation, brewer's dried grains, groundnut cake, weaner-rabbits.

Introduction

One of the solutions to the present animal protein intake deficit in developing economies lies in the intensive utilization of livestock with short generation interval (Adeyemi, 2005). Rabbit is a paradiquatic example of micro-livestock and short-cycle animal whose meat is widely accepted. The rabbit has elicited much interest because it is easy to manage, highly prolific breeder, efficient converter of plant products, and requires little capital outlay. Rabbit meat is white, fine grained, low in fat and caloric value, rich in protein and some minerals and vitamins (Aduku and Olukosi, 1990). Feed cost is always the largest item of expenditure in livestock production and protein sources are the most expensive among the ingredients used for livestock feeds. In the face of increasing challenges to produce cheap and good quality animals and animal products, there is need to intensively explore the use of agricultural and agro-based industrial by-products as replacers, substitutes and complements for the more expensive conventional ones and brewer's dried grains is one of such by-products (Isikwenu, 2006). Brewer's dried grains (BDG) is cheap, not directly required by man and supply same quality protein as groundnut cake because they have similar amino acid profile. The major limitation to the use of BDG as a source of plant protein is its high crude fibre content. Alkali treatment of various fibrous materials has been found to improve their nutritional qualities (McDonalds *et al.,* 1995; Faniyi *et al.*, 1997; Vipond *et al.*, 2001 and Isikwenu, 2006,). Dirar (1992) also showed that fermentation is one important way of improving feed ingredients which under normal circumstances are denigrated materials. Further processing of BDG in order to reduce it fibre content was carried out by use of urea-treatment and fermentation. Urea-treated and fermented BDG have been successfully used in broiler starter diets as a replacement for groundnut cake (GNC) up to 16.70% of the diet without detrimental effects (Isikwenu *et al.,* 2008), except that in this experiment the test ingredient is being applied to rabbit diets. This study was therefore designed to investigate the effect of replacing groundnut cake with urea-treated and fermented BDG in weaner rabbit's diets.

Materials and Methods

Experimental Site: This study was conducted at the rabbitry unit of the Department of Animal Science, Delta State University, Asaba Campus, with mean annual rainfall, temperature and relative humidity of 1137mm, 35.7^{0}C and 82% respectively.

Preparation of Test Ingredients: The brewer's dried grains (BDG) used in this experiment was fermented for 7 days in 2% urea concentration. To obtain the 2% urea solution, 400 g of urea (46%N, fertilizer grade) was dissolved in 20 litres of clean water to produce 2% urea solution containing 20 g urea per litre of water (Adeleye, 1988). Fourteen (14) kg of BDG was weighed into the 20 litre urea solution and thoroughly mixed to obtain uniform wetness and excess solution was allowed to drain off on a standard sieve. The material was put into thick polythene bag, sealed and stored under shade to ferment for 7 days. At the end of the 7 days fermentation period, the treated BDG was sun-dried to a safe moisture level of 7-15% and used for feed formulation. The proximate composition of groundnut cake, urea-treated and fermented BDG and untreated BDG were as determined by Aduku (1993) and Isikwenu (2006).

Experimental Diets: Urea-treated and fermented BDG was used to replace GNC at 0, 25, 50, 75 and 100% levels in weaner rabbits diets on protein equivalent basis. Five diets were formulated to be isonitrogenous and isocaloric to provide 18% crude protein and 2600 kcal/kg metabolizable energy.

Experimental Rabbits and Management: Thirty, eight weeks old weaner rabbits of mixed breed and sexes with initial weight of 808-810 g were used for the ten weeks feeding trial. The rabbits were randomly allotted into five treatment groups on equal weight and sex basis in a completely randomized design (CRD). Each treatment group consisted of six rabbits and three replicates of two rabbits each and kept in a single tier hutch of 75 cm x 75 cm x 60 cm dimensions. Feed, fresh green forage (*Panicum maximum, Talinum triangulare* and *Tridax procumbens*) and water were provided *ad libitum*. Data on weight performance, feed intake, feed conversion ratio and mortality were recorded weekly on replicate basis for the experimental period. At the end of the feeding trial, one rabbit was randomly selected from each replicate, weighed and slaughtered by severing the jugular vein and carotid arteries and skinned for carcass measurement. The cost per kg feed, cost of feed consumed and the cost of feed per kg weight gain were used to estimate the economics of production.

Statistical Analysis: Data collected were subjected to analysis of variance and treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955) using SPSS (10.0) package.

Table 1: Composition of Experimental Weaner Rabbit Diets

	Dietary Treatment				
Ingredient	D_1 (control)	D_2	D_3	D_4	D_5
Maize (White)	54.00	53.10	51.90	51.00	49.90
Groundnut cake	20.00	15.00	10.00	5.00	---
Urea-Treated BDG	---	5.90	12.10	18.00	24.10
Wheat offals	20.75	20.75	20.75	20.75	20.75
Fish Meal	1.50	1.50	1.50	1.50	1.50
Bone Meal	2.35	2.35	2.35	2.35	2.35
Oyster Shell	1.10	1.10	1.10	1.10	1.10
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude Protein (%)	18.07	18.01	18.04	17.99	17.99
Crude Fibre (%)	4.32	4.36	4.42	4.48	4.54
Metabolizable Energy (k cal/kg)	2662.05	2652.96	2641.09	2631.99	2621.05.

Table 2: Chemical Composition of Groundnut Cake, Untreated BDG and Treated and Fermented BDG (Test Ingredient)

Parameter %	GNC	Untreated BDG	Urea-treated BDG
Dry matter	92.00	93.34	88.76
Crude Protein	45.00	24.21	38.52
Crude Fibre	3.81	11.20	4.49
Ether Extract	9.16	3.69	4.87
Ash	5.51	8.04	5.99
Nitrogen Free Extract	-	46.20	34.89
Organic Matter	86.49	85.30	82.77
Metabolizations Energy (kcal/kg)	2530.00	2513.00	2520.00

Source: (Aduku, 1993 and Isikwenu, 2006)

Results

The compositions of the weaner rabbit diets are presented in Table I. The proximate composition of urea-treated and fermented BDG, untreated BDG and groundnut cake are presented in Table 2. The performance of rabbits is presented in Table 3. There were significant (P<0.05) differences in the final body weight, daily body weight gain, feed intake and feed conversion ratio of rabbits fed the different diets. The rabbits fed the control diet were significantly (P<0.05) different from those fed diet with 100% urea-treated and fermented BDG inclusions in final body weight and daily body weight gain but similar (P>0.05) to those fed with 25-75% inclusion levels. The feed intake of the rabbits fed the control diet were significantly (P<0.05) higher than all the treatment groups with urea-treated and fermented BDG inclusions. The feed conversion ratio of rabbits fed the control diet were significantly (P<0.05) better than those on diets with 75% and 100% treated BDG inclusions but similar (P>0.05) to those fed 25 and 50% inclusion levels. Mortality level (3-7%) was normal and evenly spread across treatment groups. The results of the carcass characteristics of the rabbits fed the experimental diets are presented in Table 4.

The dressed weight and weights of all cut up parts are expressed as percent of the slaughter weight. The dressed weight, head weight, tail and feet and skin (pelt) weights as percent of slaughter weight for all treatment groups were not significantly (P<0.05) different. The slaughter weight of rabbits fed the control diet were similar (P>0.05) to those fed 25 and 50% inclusion levels but significantly (P<0.05) higher than those fed 75 and 100% urea-treated and fermented BDG diets. The shoulder/forelegs and thigh/hindlegs weights of rabbits fed the control diet were significantly (P<0.05) higher than those fed urea-treated and fermented BDG diets, except for 25% inclusion level that was similar (P>0.05) to the control in thigh/hindlegs weight.

The rack/rib weights of the control diet were similar (P>0.05) to those fed 25 and 50% urea-treated BDG diets but significantly (P<0.05) higher than those fed 75 and 100% urea-treated BDG inclusions. The loin weight followed the same pattern as the rack/rib weights but significant (P>0.05) differences exist between the control and 50, 75 and 100% urea-treated BDG diets.

Table 3: Performance Characteristics of Rabbits Fed Experimental Diets

Replacement Level (%)	00UTBDG 100GNC 1	25UTBDG 75GNC 2	50UTBDG 50GNC 3	75UTBDG 25GNC 4	100UTBDG 00GNC 5
Initial Body Wt (g)	809.00	808.00	810.00	808.00	808.00
Final Body Wt (g)	1993.30± 0.12[a]	1780.00± 0.11[ab]	1830.00± 0.10[ab]	1686.70± 0.16[ab]	1500.00±0.05[b]
Body Weight gain (g/rabbit/day)	16.92± 0.17[a]	13.89± 0.14[a]	14.57± 0.07[a]	12.60± 0.15[a]	9.89± 0.06[b]
Feed intake (g/rabbit/day)	70.34± 1.03[a]	16.99± 0.65[b]	63.22± 1.24[b]	64.87± 1.22[b]	66.42± 0.57[b]
Feed conversion Ratio	4.16± 0.01[a]	4.17±0.01[a]	4.20± 0.01[ab]	4.35± 0.01[b]	6.72±0.01[c]
Mortality (%)	3	Nil	7	Nil	3

Means with different superscripts a, b in the same row are significantly different (P< 0.05). UTBDG: Treated and Fermented Brewer's dried grains. GNC: Groundnut Cake.

Table 4: Carcass Characteristics of Rabbits Fed Experimental Diets

Replacement Level (%)	00UTBDG 100GNC 1	25UTBDG 75GNC 2	50UTBDG 50GNC 3	75UTBDG 25GNC 4	100UTBDG 00GNC 5
Live Wt (g)	1993.30± 0.12[a]	1780.00± 0.11[ab]	1830.00± 0.10[ab]	1686.70± 0.16[ab]	1500.00± 0.05[b]
Slaughter wt (g)	1630.00± 0.11[a]	1443.30± 0.01[abc]	1473.30± 0.01[ab]	1266.70± 0.14[bc]	1123.30± 0.01[c]
Dressed wt*	61.43± 0.60[a]	6 4.61± 1.83[a]	64.78±2.33[a]	67.44± 2.64[a]	62.28± 1.96[a]
Head weight*	12.37± 0.83[a]	12.79± 1.37[a]	11.96± 0.22[a]	13.19± 0.23[a]	11.85± 1.43[a]
Shoulder/forelegs*	18.49± 0.43[a]	17.13± 0.24[b]	16.80± 0.14[bc]	16.04± 0.28[cd]	15.24± 0.28[d]
Rack/Rib wt*	16.12± 0.19[a]	15.93± 0.32[ab]	15.58± 0.14[abc]	15.40± 0.17[bc]	15.05± 0.18[c]
Loin Weight*	20.68± 0.12[a]	20.04± 0.22[ab]	19.10± 0.34[bc]	18.83± 0.06[c]	17.78± 0.53[d]
Thigh/Hindlegs wt*	39.22± 0.22[a]	38.53± 0.28[ab]	37.97± 0.31[bc]	37.25± 0.12[cd]	36.67± 0.19[d]
Tail + 4 feet wt*	5.03± 80[a]	6.99± 0.46[a]	5.12± 0.67[a]	6.63± 1.38[a]	4.45± 0.05[a]
Pelt (skin) wt*	12.14± 0.96[a]	12.79±1.37[a]	12.41± 0.55[a]	14.19± 2.57[a]	14.86± 1.59[a]
Full GIT wt*	18.75± 1.11[b]	19.69± 090[b]	20.54± 1.37[b]	29.40± 3.48[a]	29.61± 2.58[a]

**: %Slaughter weight. Means with different superscripts a, b, c, d, in the same row are significantly different (P< 0.05) GIT: Gastro Intestinal track; UTBDG: Treated and fermented brewer's dried grains; GNC: Groundnut Cake.*

The full gastro intestinal track (GIT) weight of rabbits fed the control, 25 and 50% diets were similar (P>0.05) but significantly (P<0.05) lower than those fed 75 and 100% urea-treated BDG diets. The lungs, kidneys and spleen weights were not significantly (P>0.05) different in all treatment groups. The heart weight of rabbits fed with the control diet were similar (P>0.05) to all urea-treated BDG diets except the diet with 75% inclusion level. The liver weight of treatment groups with 75 and 100% urea-treated BDG inclusions were significantly (P<0.05) higher than the control, 25 and 50% inclusion levels.

Table 5: Organ Characteristics of Rabbits Fed Experimental Diets

Replacement Level (%)	00UTBDG 100GNC 1	25UTBDG 75GNC 2	50UTBDG 50GNC 3	75UTBDG 25GNC 4	100UTB 00GNC 5
Heart t*	0.37± 0.04^{b}	0.40± 0.03^{ab}	0.36± 0.02^{b}	0.46± 0.03^{a}	0.40± 0.01^{a}
Lungs wt*	0.68± 0.03^{a}	0.69± 0.04^{a}	0.76± 0.09^{a}	0.74± 0.08^{a}	0.65± 0.05^{a}
Liver t*	3.36± 0.23^{b}	3.17± 0.25^{b}	2.79± 0.11^{b}	4.36± 0.43^{a}	5.16± 0.34^{a}
Kidney wt*	0.75±0.09^{a}	0.83± 0.05^{a}	0.83± 0.06^{a}	0.81± 0.03^{a}	0.90± 0.03^{a}
Spleen wt*	0.07± 0.03^{a}	0.06± 0.01^{a}	0.07±0.01^{a}	0.05±0.01^{a}	0.03± 0.01^{a}

Means with different superscripts a, b in the same row are significantly different (P< 0.05); *: %Slaughter weight;

UTBDG: Treated and fermented brewer's dried grains; GNC: Groundnut Cake.

The result of the organ weights of rabbits fed the experimental diets are presented in Table 5. The organ weights are expressed as percent of the slaughter weight.

Table 6: Economic Analysis of Rabbits Fed Experimental Diets

Replacement Level (%)	00UTBDG 100GNC 1	25UTBDG 75GNC 2	50UTBDG 50GNC 3	75UTBDG 25GNC 4	100UTBDG 00GNC 5
Total Feed/rabbit (kg)	4.92± 0.06^{a}	4.06± 0.01^{c}	4.43± 0.12^{b}	4.54± 0.12^{b}	4.65± 0.12^{ab}
Cost / kg feed (#)	104.40± 0.52^{a}	97.53± 0.44^{b}	90.44± 0.35^{c}	83.58± 0.46^{d}	76.56± 0.35^{e}
Feed cost/rabbit (#)	513.40± 0.98^{a}	395.97± 0.57^{c}	400.65± 0.18^{b}	379.45± 0.52^{d}	356.00± 1.15^{e}
Cost of feed /kg wt gain (#)	257.73± 0.46^{a}	222.46± 0.46^{d}	218.93± 0.12^{e}	225.06± 0.54^{c}	237.33± 0.40^{b}
Cost differential /kg gained (#)	-	26.34± 0.40^{b}	40.93± 0.17^{a}	3.50± 0.06^{c}	-80.73± 0.12^{d}
Relative Cost-Benefit /kg gain (%)	100.00± 0.00^{d}	106.47± 0.06^{b}	110.42± 0.06^{a}	100.81± 0.06^{e}	84.31± 0.12^{e}

Means with different superscripts a, b, c, d, e in the same row are significantly different (P< 0.05);
UTBDG: Treated and fermented brewer's dried grains; GNC: Groundnut Cake.

The results of the economic analysis of rabbits fed the experimental diets are presented in Table 6. The total feed consumed (kg/rabbit) for the control was significantly (P<0.05) higher than 25, 50 and 75% urea-treated and fermented BDG diets but similar (P>0.05) to the 100% inclusion level. The cost of producing a kg of feed and the total cost of feed consumed per rabbit were significantly (P<0.05) lower in all urea-treated BDG diets. The cost of feed per kg weight gain were significantly (P<0.05) higher in the control than urea-treated and fermented BDG diets and 50% replacement level had the lowest cost per kg gain. The cost differential and relative cost benefit per kg gain were significantly (P<0.05) higher in rabbits fed with 50% urea-treated and fermented BDG diets.

Discussion

The final body weight and daily body weight gain of rabbits were similar for the control and treatment groups with 25, 50 and 75% urea-treated and fermented BDG diets. This implies that these replacement levels were able to furnish adequate nutrients to obtain a growth rate comparable to the control diet. It also indicated that weaner rabbits can tolerate inclusions of urea-treated and fermented BDG up to 75%, which is about 18.00% of the diet. These replacement levels are therefore, within the optimum range that can be used for good body weight performance and these results are in agreement with those reported by Sobayo *et* al. (2008). The rabbits ate significantly more of the control diet than urea-treated BDG based diets, indicating that the control diet was more palatable and acceptable to the rabbits. However, the feed intake of treatment groups on 25, 50 and 75% inclusion levels were able to furnish the rabbits adequate nutrients to obtain a comparable growth rate to the control.

The observed similarity of the feed conversion ratio of rabbits fed the control, 25 and 50% inclusion levels followed the same trend as the growth performance. The values of the slaughtered weights of rabbits are related to the feed conversion ratio pattern, which means the inclusion levels of 25 and 50% urea-treated BDG were able to provide nutrients for tissue synthesis to sustain a growth rate similar to the control diet. The lower weights of rabbits fed 75 and 100% levels of urea-treated BDG diets may have resulted from nutrient intake restriction precipitated by nutrient dilution effect of crude fibre and bulkiness of feeds. This result is supported by antecedent reports on the implication of restricted feed intake (Mench, 2002; Erakpotobor and Umeh, 2005) on growth rate and body weight performance.

The dressed weight, head weight, tail and feet, and skin weights were similar and are an indication that body growth obtained were proportionally adequate and characteristic of the rabbit, meaning diets had no detrimental nutritional deficiencies. In the cut-up parts, the rabbits fed the control diet were better in shoulder/forelegs weights, had similarity with rabbits fed 25% urea-treated BDG diet in loin and thigh/hindlegs weights and in rack/rib weights were similar to those fed up to 50% urea-treated inclusion levels. The differences in the weights of the cut-up parts are a true reflection of the overall body weight performance of rabbits in all treatment groups. Njidda *et al.* (2006) and Idowu *et al.* (2006) obtained values within the same range of those in this study. However, the 25% urea-treated BDG inclusion level which compared favourably with the control showed that it can furnish adequate nutrients for tissue synthesis of the different body parts at the same level as the control.

The downward trend of weight performance is associated with the effect of increased fibre load of diets as urea-treated BDG inclusion increased. The full gut weight of rabbits fed 75 and 100% urea-treated BDG diets were significantly heavier because they ate diets with higher fibre content. Gut weights and lengths are increased by high fibre diets (Savory and Gentle, 1976a, b, Hetland and Svihus, 2001 and Hetland *et al.*, 2003). The observed similarity in heart, lungs, kidneys and spleen weights of rabbits in all treatment groups may be a confirmation that the incorporation of urea-treated and fermented BDG in place of GNC in rabbit diets does not cause any toxicity or abnormal metabolic activities in their organs and systems. The values of organ weights obtained in this study are in agreement with those of Idowu *et al.* (2006), and Njidda *et al*. (2006). However, the higher liver weight of rabbits fed 75 and 100% inclusion levels could be attributed to some other unidentified factors as this did not reflect in the other organs. The reduction in the calculated cost of a kg of feed with incremental levels of urea-treated and fermented BDG followed from the reduced cost of production of urea-treated BDG relative to the cost price of GNC.

The decrease in feed cost between the control diet of ₦104.40 per kg feed and that of diet with 50% replacement of GNC that cost ₦90.44 per kg feed represent a 13.37% reduction in the cost of making 1kg of feed. A saving of this magnitude on feed will be of great benefit since feed alone accounts for about 80% of recurrent expenditure in rabbit production. Therefore, the cost of producing 1kg of meat decreased from ₦257.73 for the control to ₦218.93 for 50% replacement of GNC, representing a 15.05% reduction in cost.

The cost differential and relative cost-benefit results also showed the highest gain per kg meat at 50% replacement of GNC with urea-treated and fermented BDG in the diets. This is an indication of a favourable cost analysis which could be interpreted to mean a positive response to urea-treated and fermented BDG as replacement for GNC in rabbit diets.

Conclusion

Based on the overall results of weight performance, low mortality rate, carcass quality and reduced cost (15.05%) of production, the use of urea-treated and fermented BDG in weaner rabbit diets in place of GNC is highly advocated. It was found that urea-treated and fermented BDG can replace up to 50% GNC (12.10% of the diet) as an alternative plant protein source in weaner rabbit diets.

References

Adeleye, I.O.A., 1988. Treatment of low quality roughages and agronomic residues for livestock feedings; Their technology, applicability and adaptability to local conditions. Invited paper presented at the workshop on Alternative Formulation of livestock feeds in Nigeria, Nov. 21st 1988. University of Ibadan, Ibadan Nigeria.

Adeyemi, A.O. 2005. Nutritional Evaluation of Broiler Diets Formulated with Enriched Unpeeled Cassava Root Meal Fermented with Rumen Filtrate. PhD. Thesis, University of Agriculture, Abeokuta, Nigeria. p185.

Aduku, A.O. and Olukosi, J.O. 1990. Rabbit Management in the Tropics – Production, Processing, Utilization, Marketing, Economies, Practical, Training, Research and Future. Living Rocks Publishers, Abuja pp 43-56.

Dirar, H.A. 1992. Traditional fermentation technology and food policy in Africa. *Appropriate Technology*. 19 (3): 21-23.

Duncan, D.B. 1955. Multiple range and multiple F-tests. *Biometrics* 11:1 - 42.

Erakpotobor, P.W. and Umeh, J 2005. Effect of quantitative feed restriction on growth performance and age at first lay of pullets. In: Fanimo, A.O., Peters, S.O., Idowu, O.M.O., Ola, S.I., & Sonaiya, E.B, (Eds.) Emerging Opportunities for Poultry Production in West Africa. Proc. 1st Nigeria International Poultry Summit (NIPS), Feb. 20th – 25th 2005. Ota, Ogun State Nigeria. Pp. 77 – 78.

Faniyi, G.F., Ologhobo, A.D., Adeniran, G.A. and Alaka, O.O. 1997. Protein enrichment of cowpea and sorghum seed hulls for poultry feeding by fermentation in poultry faces. In: Ologhobo, A..D and Iyayi, E.A (Eds.) Livestock Products. Proc. 2nd Annual. Conference of Animal Science Association of Nigeria, Sept. 16th – 17th, 1997, Ikeja-Lagos. pp. 52 – 63.

Hetland, H. and Svihus, B. 2001. Effect of oats hulls on performance, gut capacity and feed passage time in broiler chickens. *British Poultry Science* 42:354 – 361.

Hetland, H., Svihus, B. and Krogdahl, A. 2003. Effects of oat hulls and wood shavings on digestion in broilers and layers fed diets based on whole or ground wheat. *British Poultry Science* 44: 275 – 282.

Idowu, O.M.O., Sogunle, O.M., Idowu, O.A., Jegede, A.V., Alabi, E.E., Adenugba, A.O. and Bamgbose, A.M. 2006. Performance and carcass characteristics of weaner rabbits fed diets containing cassava root peel and cassava root sievate. *Tropical Journal of Animal Science* 9(1): 81 – 87.

Isikwenu, J.O. 2006. The Use of Urea-Treated and Fermented Brewer's Dried Grains in Poultry Diets. PhD. Thesis, Department of Animal Science, Delta State University, Abraka.

Isikwenu, J.O., Omeje, S.I., Okagbare, G.O. and Akpodiete, O.J. 2008. Effect of replacing groundnut cake with urea-treated Brewer's dried grains in broiler chicks diets. *Animal Research International* 5(1): 795 – 800.

McDonald, P., Edwards, R.A. and Greenhalgh, I.F.D. 1995. Animal Nutrition (5th ed.) Longman Scientific and Technical. England.

Mench, J.A. 2002. Broiler Breeders: Feed restriction and welfare. *Worlds Poultry Science Journal* 58:23 – 29.

Njidda, A.A., Igwebuike, J.U. and Isidahomen, C.E. 2006. Haematological parameters and carcass characteristics of weanling rabbits fed graded levels of molasses. *Global Journal of Agricultural Sciences* 5(2): 167 – 172.

Savory, C.J. and Gentle, K.J. 1976a. Effects of dietary dilution with fibre on the food intake and gut dimension of Japanese Quail. *British Poultry Science* 17:560 – 570.

Savory, C.J. and Gentle, K.J. 1976b. Changes in food intake and gut size in Japanese Quail in response to manipulation of dietary fibre content. *British Poultry Science* 17: 571 – 580.

Sobayo, R.A., Okubanjo, O.A., Adeyemi, O.A. and Usman, J.M. 2008. Nutritional evaluation of graded levels of fermented maize milling waste (maize gluten) in rabbit diet. *Nigerian Journal of Animal Production* 35(1): 76 – 81.

Statistical Package for Social Sciences (SPSS) Version 10.0

Vipond, J.E., Lewis, M. and Allcroft, D.T. 2001. Urea preserved grains for finishing Lambs. Proc. Of British Society of Animal Science. pp 111 – 118.